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EFFECT OF IRRIGATION ON RADIAL GROWTH IN LARGE PONDEROSA PINE TREES

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Many workers have shown the beneficial effect of abundant moisture on the radial growth of forest trees. During a discussion of this subject with F. P. Keen, the question arose whether irrigation would revive high risk trees sufficiently to make them no longer susceptible to bark beetle attack. As a consequence of this discussion, a small scale test was planned involving six high risk trees (Class 4C, risk 4), three of which were to be watered and three to be unwatered checks.

The six trees were selected near the Meryl Springs camp and during 1940 and 1941 three of them were provided with water through a small irrigation ditch. Since the soil in this area is a shallow sandy-loam pumice over large basaltic boulders, allowing almost excessive drainage, the small stream of water was permitted to run throughout the field season. This was only from August 13 to October 2 in 1940, but was for the full season from May 10 to October 24 in 1941.

During the 1941 season, it was learned that irrigation had been started at the McCartie-MacKendree sheep headquarters during 1935. This irrigation work was on an annual basis from early spring till late fall and had been done carefully so as to produce green summer pasture in an ordinarily barren rock flat. This was thought an excellent opportunity to study the effect of proper moisture for seven years on nearby ponderosa pine trees. Consequently, a series of twenty increment cores was taken from this area. The trees sampled comprised ten high risk, Class 4C Risk 4 trees, five irrigated and five unwatered; and ten low risk, Class 2B Risk 1 trees, five irrigated and five unwatered.

Results of Irrigation Evidenced in Crowns

Crown descriptions were recorded for the six trees at Meryl Springs when the test was started in August 1940, and changes were noted when cores were taken in October 1941. No records are available for the trees at the McCartie-MacKendree camp when irrigation was begun in 1935, but crown descriptions were recorded when cores were taken in October 1941.

As far as could be ascertained by visual means, there were only minor changes in the crowns of the trees irrigated at Meryl Springs. There appeared to be some slight improvement in needle length and a lessening in the number of dying twigs in the watered trees, but this was quite general throughout the locality so that it was accordingly discounted. Two of the unwatered check trees were attacked by the western pine beetle during the summer of 1941, so that two new check trees had to be selected. Spike-topped trees were equally represented among the watered and unwatered trees--two trees in each group had this injury.

The watered and unwatered trees in the McCartie--McKendree series were selected to be as nearly similar as possible, according to crown conditions at the time of examination, so that no great differences occur in crown appearance, except between the low and high risk trees. In general, however, most of the trees within the irrigated area appeared to be more vigorous than the nearby unwatered trees because of slightly longer, greener needles and fewer dying twigs. Spike-topped trees were equally represented with three each in the irrigated and unwatered high risk groups. No spikes were present in either of the low risk groups.

Results of Irrigation Evidenced in Radial Growth

Plate I shows the comparison in percent normal growth between the watered and unwatered trees, both high and low risk, on the two different areas. Normal growth was considered as the mean annual radial growth for the period from 1900 to 1929 inclusive. No change in radial growth, attributable to more abundant moisture, is apparent in the watered trees at Meryl Springs. The growth patterns for both check and watered trees in this area are somewhat lower than the normal pattern for the locality, but otherwise follow it closely in general fluctuations.

This lack of response to irrigation may have resulted from a number of causes. It is believed, however, that irrigation was started too late in 1940 to have been of any benefit during the main period of summer wood growth, so that no appreciable effect was recorded for that season. During 1941, precipitation was sufficiently abundant throughout the region to produce marked improvements in radial growth in all trees. Hence, moisture provided by irrigation was probably in excess of normal requirements, yet not sufficient to be detrimental. That is, soil moisture was probably maintained somewhere in the wide range between wilting coefficient and field capacity wherein there is no great difference in the force which holds the moisture in the soil. Thus, the moisture provided by irrigation would show no effect on the radial growth of the watered trees. This theory is further substantiated by the growth patterns of cores taken in the McCartie-MacKendree series, and by the work of Lodewick,[1] Schantz,[2] and Veihmeyer.[3]

In general, a striking improvement in growth after 1934 is apparent in the cores from the watered trees of the McCartie-MacKendree series. The greatest difference is shown by comparing the watered and unwatered high risk trees. Prior to irrigation in 1935, radial growth in the watered trees was somewhat lower and appeared to be declining steadily, but in 1935 and thereafter it improved rapidly regardless of normal fluctuations. A similar growth improvement is evident in the cores from the low risk trees, although the upward trend actually began in 1934 prior to irrigation. However, this difference is no more than the variability evident in all curves due to the small number of samples represented in these data. The general trends are sufficiently strong to indicate a marked improvement in radial growth resulting from the irrigation.

One other point to be noted in plate I is the nearly proportionate increases shown by all four curves in 1937, 1939, and 1941 (excepting the watered low risk trees in 1941). This is in line with what was mentioned previously, that moisture in excess of the normal tree requirement has no effect on it until the moisture becomes too great and begins to interfere with normal soil aeration. This permits a rather wide range in soil moisture which is the optimum for plant growth.

Conclusions

No definite conclusions can be drawn from these observations because of the variability in the data. They do, however, suggest the following possibilities:

1. Irrigation increases the radial growth of ponderosa pines in years when precipitation is insufficient to supply normal moisture requirements.

2. This improvement in radial growth is evident even in spike-topped trees which have lost fully 50 percent of their crowns.

3. During the first seven years of irrigation, improvement in radial growth is not accompanied by a corresponding improvement in crown volume in old trees, except for slight lengthening of the needles and darkening of their green color.

4. Controlled studies of the effects of soil moisture on ponderosa pine development will yield extremely interesting information of great value to the study of current heath symptom evaluation.

References

(1) Lodewick, J. E. Some effects of irrigation and fertilization on the size of longleaf pine needles. Forest Worker Jan. 1931.

(2) Schantz, H. L. Soil moisture in relation to the growth of crop plants. Jour. Am. Soc. Agron. 17:705-711. 1925.

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PLATE I

PERCENT NORMAL RADIAL GROWTH IN WATERED
AND UNWATERED PONDEROSA PINES